STUDIES IN THE GENUS *UROMYCLADIUM*. II.

NOTES ON THE DIKARYON STAGE OF UROMYCLADIUM TEPPERIANUM.

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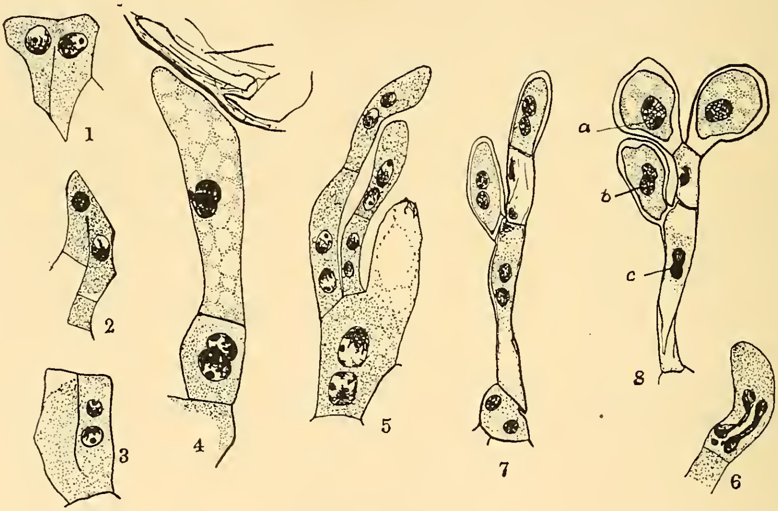
(Sixteen Text-figures.)

[Read 24th April, 1935.]

Since the publication of Part I of these studies (these Proc., lix, 1934, p. 212), certain circumstances have arisen which make it unlikely that the writer will be able to continue this work on the life history of *Uromycladium* for some years. It was thought advisable, therefore, to place on record observations made to date on the dikaryon stage. As in the previous study, the material chosen for examination was stems of *Acacia stricta* Willd., infected with *Uromycladium Tepperianum* (Sacc.) MacAlp.



Text-figs. 1-8.

1.—Cell fusions in the developing teleutosorus. 2.—Cell fusion showing the suggestion of movement of the nucleus. 3.—Cell fusion showing both nuclei lying in the one cell. 4.—Hymenial cell and buffer cell. Crushed cells of host above. 5.—Hymenial cells with collapsed buffer cell and two spore-head initials. 6.—Conjugate division in the spore-head initial. 7.—Developing spore-head. 8.—A later stage in the development. Figs. 1-6, ×1,500 ; 7-8, ×1,250.

The first indication of the formation of the teleutosorus in this species is a massing of hyphae, several layers of host cells deeper than the pycnia but connected with them by numerous strands of hyphae. Formation of the dikaryon stage is by equal cell fusion in this hyphal mass (see Text-figs. 1, 2, 3); apparently any two cells may unite. Sometimes one of the fusing nuclei may migrate so that both lie in the same cell. When this occurs there follows usually a contraction of the cytoplasm in the non-nucleated portion (Text-fig. 3). Simultaneous divisions of the nuclei follow and a very limited binucleate mycelium is formed, seldom more than three or four cell-layers deep. Extension of the young sorus seems to be brought about by further nuclear migrations rather than by continued division of the first-formed binucleate hyphae.

Cells from the outer part of the binucleate zone form the hymenium. These cells are but little differentiated at first, but they enlarge somewhat as they grow older. By division they give rise to a row of buffer cells; these elongate rapidly (Text-fig. 4) and by their growth crush and eventually cause the shedding of the outer layers of the host tissue. In the later stages these buffer cells become vacuolated and then collapse. The formation of the buffer layer is not regular and frequently the pressure of the developing spores themselves causes the shedding of the external layers of host tissue.

Text-figs. 9-16.

9.—A very young spore with two nuclei. 10.—Fusion nucleus. 11.—Fusing nucleus showing aggregation of chromatin into masses. 12.—Fusion nucleus showing contraction of chromatin. 13, 14, 15.—Reorganization of the diploid nucleus. 16.—Mature spore: *a*, cross-section; *b*, longitudinal section. Figs. 9-16, × 1,500.

Teleutospore initials arise either directly, or as lateral outgrowths from the hymenial cells at the side of the buffer cells (Text-fig. 5). The developing hypha elongates slightly and typical conjugate division of the nuclei takes place (Text-fig. 6). The stages of segmentation have been figured diagrammatically in a previous paper (Burges, 1934).

The thickening of the spore wall takes place very irregularly (Text-figs. 7, 8) and the developing spore undergoes many changes in shape. Nuclear fusion begins about the same time as the thickening of the spore wall. Two nuclei prior to fusion are shown in Text-figure 9. They each possess a well-marked nucleolus and a deeply staining chromatin mass. On coming into contact, the membranes of the nuclei break down and the contents begin to fuse. The chromatin, which is more or less irregular at this stage (Text-fig. 10), aggregates into isolated lumps (cf. Text-fig. 11). The nucleoli fuse and the chromatin material tends to contract towards one side of the nucleus (Text-fig. 12). The young spore by this time has reached its adult size. Changes in the chromatin distribution continue, resulting in its more even distribution throughout the nucleus (Text-figs. 13, 14, 15). The nucleus then shrinks slightly and remains in the resting condition till germination occurs.

The mature spores (Text-fig. 16) are depressed-globose in shape and deeply striated by longitudinal furrows as is shown in cross-section (Text-fig. 16*a*). There is a well-marked apical germ pore and a basal hilum. At maturity the stalk-cell elongates rapidly and carries the spore-head well up above the hymenium. The spores are shed and the pedicel shrivels. Further lateral growths from the hymenial cells give rise to more spore-heads. The spores when shed tend to dry out and contract, so that the hilum is drawn near to the germ pore. Their viability seems to be dependent on the amount of desiccation to which they are subjected. In the winter they may retain their viability for weeks, but in the summer a few hot days in the dry weather kills the majority of spores.

Spores germinated in the laboratory with the production of a copious growth of germ-tubes, but in all cases abnormal growth resulted. No sporidia were formed, even when spores were sown on gelatine or agar films in varying humidities.

This work was carried out in the Botany School of the University of Sydney, and my thanks are due to Professor Osborn for the facilities afforded me there.

Summary.

1. The dikaryon stage is formed by equal cell fusion, but the nuclei may move so that both lie in the same cell.

2. The binucleate mycelium is very limited and may consist of only one or two layers of cells.

3. Buffer cells cut off from the hymenial zone help to shed the outer layers of the host.

4. Spore-head initials arise from the hymenial cells and segment to give three spores.

5. Nuclear fusion occurs in the developing spores.